



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: **ACTION**: Review and Concurrence, Equivalent Level of
Safety Finding for Cessna New Model 680, Direction
Indicator; FAA Project #TC2548WI-T

Date: **April 15, 2004**

Reg Ref: §§ 25.1301(a)(d),
25.1303(a)(3),
25.1309(a)(b)(d)(e),
25.1316, 25.1321,
25.1327, 25.1331,
25.1333, 25.1351(d),
25.1353(a)(c),
25.1459(e)

From: Manager, Airplane and Flight Crew Interface Branch,
ANM-111

Reply to
Attn. of: Bryan Easterwood,
ACE-116W

To: Manager, Wichita Aircraft Certification Office, ACE-
115W

ELOS
Memo #: TC2548WI-T-SE-5

Background

Cessna eliminated the non-stabilized magnetic compass literally referred to in § 25.1303(a)(3). The Cessna Model 680 contains an electric full time standby suite consisting of a Secondary Flight Display (SFD), and a separate Horizontal Situation Indicator (HSI). The SFD provides and displays a third source for attitude, airspeed, and altitude information. The HSI displays a third heading, utilizing a remotely mounted magnetic flux detector with gyroscopic stabilization provided by the SFD attitude source. If the data link between the SFD and HSI were to fail or if the HSI were to otherwise fail rendering the HSI heading display invalid, heading would be displayed on the SFD. All sensors used by the standby suite are independent from the primary sensors used by the two primary display systems. All functions associated with the standby direction indicating system are independent of the main aircraft systems, including lighting, power, stabilization, and magnetic direction sensing. The standby suite will be powered by the standby battery pack located in the nose of the aircraft and will remain powered for a determined minimum time duration after loss of all normal (generators) sources of electrical power. The standby battery pack is independent from the two aircraft main batteries.

The standby suite provides a display format in a traditional attitude display over the horizontal situation arrangement. By reducing the instrument scan, this allows the flight crew to have a smoother transition to the standby instruments in a condition that would warrant its use. The direction indicator would be in close proximity with attitude, airspeed, and altitude information in a presentation very similar to the primary flight displays.

Applicable regulation(s)

Section 25.1301(a)(d) – Equipment – Function and installation, § 25.1303(a)(3) – Flight and navigation instruments, § 25.1309(a)(b)(d)(e) – Equipment, systems, and installations, § 25.1316 – System lightning protection, § 25.1321 – Instruments: Installation – Arrangement and visibility, § 25.1327 – Magnetic direction indicator, § 25.1331 – Instruments using a power supply, § 25.1333 – Instrument systems, § 25.1351(d) – Electrical Systems and Equipment - General, § 25.1353(a)(c) – Electrical equipment and installations, § 25.1459(e) – Flight recorders

Regulations requiring an ELOS

Section 25.1303(a)(3) – Flight and navigation instruments

Description of compensating design features or alternative standards which allow the granting for the ELOS (including design changes, limitations or equipment need for equivalency)

1. Loss of all heading display in the cockpit will be shown to be extremely improbable.
2. Standby heading information will be provided after loss of normal electrical power (both main engine generators inoperative) utilizing a stand-alone battery pack to power the instruments and sensor.
3. The Sovereign Standby Instrument Suite consisting of the Secondary Flight Display, Horizontal Situation Indicator and Magnetometer was tested to meet the critical display environment for HIRF.
4. The Sovereign Standby Instrument Suite was tested to meet the critical display requirements for Indirect Effects of Lightning (IEL).
5. The software level of the HSI is level C and level B for the Secondary Flight Display (SFD). Heading information is normally displayed on the HSI, however if the HSI fails or losses power the heading information is automatically displayed on the SFD.

Explanation of how design features or alternative standards provide an equivalent level of safety intended by the regulation

1. Display of standby heading meets the minimum accuracy requirements given in § 25.1327, which is 10 degrees, for all flight conditions. Additionally the SFD and HSI meet the requirements of TSO C6d for heading display accuracy of 2 degrees.
2. Loss of all heading information in the cockpit was shown to be extremely improbable through the Model 680 system safety process. The minimum time duration for display of standby heading information after loss of normal electrical power is the duration of diversion, descent and safe landing plus 30 minutes.
3. The magnetometer, which is remotely located in the vertical stabilizer, senses the earth's magnetic field and provides this information to the SFD. The magnetometer is located in close proximity to the primary flux valves with sufficient separation to account for common mode failures of all three systems such as HIRF, Lightning, bird strike, rotorburst, etc. Both the primary and secondary systems were tested to meet the critical HIRF and IEL environments for critical display systems. Bird strike was shown by test or analysis that a single strike will not damage all three sensors. Location and wire routing of the three sensors has also taken into

account the effects due to rotorburst from the APU or either main engine. The sensors are separated fore and aft such that effects of an uncontained APU rotor burst have been minimized. The wire routing going forward through the main engine rotor burst zone is separated vertically to minimize the effects of a main engine rotor failure.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding in Issue Paper SE-5. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS Memorandum Number should be listed in the Type Certificate Data Sheet under the Certification Basis section. [E.g. Equivalent Safety Findings have been made for the following regulation: § 25.1303(a)(3) – Flight and navigation instruments (documented in TAD ELOS Memo TC2548WI-T-SE-5)]

/s/

Signature: Stephen P. Boyd
 Manager, Airplane and Flight Crew Interface Branch, ANM-111

Date: April 15, 2003

ELOS Originated by Wichita ACO:	Program Manager, Tina Miller	Routing Symbol ACE-117W
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